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# LETUCE GROWING IN CALIFORNIA

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## CLASSIFICATION OF LETTUCE

There are several classifications of lettuce, depending upon the character of the plant, flavor, and cultural requirements. Professor W. W. Tracy<sup>1</sup> has classified lettuce as follows: The cos, distinguished by its upright habit and long leaves; the butter, distinguished by its buttery flavor; and the crisp, distinguished by its hard, crisp texture. The cos has been subdivided into the self-closing and loose-closing division. The former is capable of producing a satisfactory leaf without tying, the latter requires tying. The butter and crisp classes are separated into cabbage-heading varieties, or those having solid heads, and the bunching, or those which do not form solid heads. There are other classifications influenced by the soil requirements and season of growth, such as Winter lettuce, which can withstand low temperatures and is rather slow growing; Spring lettuce, which heads rapidly, and Summer lettuce, which will endure the heat with less degree of injury than either of the above.

For the California grower, lettuce may be divided into two classes, the large solid-head and the loose-head. The large solid-head varieties may be subdivided according to their cold and heat-resistant qualities. As an example, the Los Angeles variety has the former quality and the Iceberg the latter.

#### IMPORTANCE OF LETTUCE GROWING IN CALIFORNIA

The recent development of the lettuce-growing industry in California has been very rapid. The acreage devoted to the production of this crop has increased from 700 acres in 1911 to 2000 acres in 1916. Although lettuce was grown in California prior to 1911, the crop was consumed principally in the local markets. During the past few years a heavy demand for California-grown lettuce has been established throughout the United States. This is due largely to the superior quality of the crop and to the favorable climatic, soil, and moisture conditions which are found in many parts of the state.

The future of the California lettuce industry seems promising as the eastern demand is increasing so rapidly that it is sometimes difficult to supply it adequately.

#### LOCATION OF LETTUCE-PRODUCING CENTERS IN CALIFORNIA

The principal lettuce-growing district of California is near Los Angeles. This section produces large quantities of lettuce throughout the year and especially during the winter. It is estimated by the Los Angeles Chamber of Commerce that the production of lettuce in Los Angeles County during 1916 amounted to 900 acres, with an output of 399,465 crates. The second section of importance is located near San Francisco, Sacramento, and Stockton. During the season 1916, 200 acres of lettuce were grown in the vicinity of San Francisco and approximately the same amount was produced at Sacramento. Aside from the above mentioned localities this vegetable is grown successfully in many other parts of the state, and there is probably not a county in which it is not produced, at least in small amounts, during some season of the year.

#### COST OF PRODUCTION

The cost of production is largely dependent upon the character of the soil, season of the year, experience of the grower and the area planted. The following cost-per-acre data have been secured from several experienced growers and at the University Farm Garden.

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<sup>1</sup>American Varieties of Lettuce. United States Department of Agriculture. Bulletin 69, p. 12.

	Per acre
Plowing 12 in. deep .....	\$ 3.00
Harrowing .....	.30
Clod mashing .....	.50
Constructing raised beds .....	10.00
Seed (3 lb. @ \$2.50) .....	7.50
Growing plants (in seed beds) .....	2.00
Removing from seed bed and transplanting to field ....	20.00
Hoeing once .....	8.00
Irrigating four times .....	8.40
Harvesting and crating (2000 doz.) .....	13.50
 Total .....	 \$73.20

Several of the above costs are variable. If the raised beds are made by hand the cost would vary from \$25 to \$30, instead of \$10. During certain seasons of the year one irrigation would be sufficient instead of four. In figuring the labor costs it is assumed that the laborer will receive twenty-five cents per hour, nine hours constituting a working day.

#### YIELDS AND PRICES RECEIVED

The yields vary from 1500 dozen to 2500 dozen marketable heads per acre, with an average yield of 2000 dozen. Growers who ship to wholesale houses receive eight to twenty cents per dozen heads, the usual price varying from ten to fifteen cents.

In table I will be found the average monthly quotations for lettuce on the Los Angeles market from 1911 to 1915, inclusive.<sup>2</sup> These figures represent the prices which the wholesale broker quotes to the retail buyer.

TABLE I

Month	Year	Av. price per crate	Month	Year	Av. price per crate
January	1911	\$ .80	July	1911	1.00
	1912	1.37		1912	.82
	1913	1.04		1913	.96
	1914	.95		1914	.98
	1915	.87		1915	1.05
February	1911	1.00	August	1911	1.00
	1912	1.27		1912	.95
	1913	1.16		1913	.87
	1914	.93		1914	.94
	1915	.81		1915	1.10

<sup>2</sup> Compiled by Professor A. T. Potts of the Texas Agricultural College, while studying at the University of California.

Month	Year	Av. price per crate	Month	Year	Av. price per crate
March	1911	1.15	September	1911	1.19
	1912	1.12		1912	.95
	1913	1.07		1913	.95
	1914	1.25		1914	.91
	1915	.94		1915	1.14
April	1911	\$1.15	October	1911	.99
	1912	.96		1912	.82
	1913	.92		1913	.53
	1914	.94		1914	.78
	1915	.85		1915	1.00
May	1911	1.69	November	1911	1.12
	1912	.82		1912	.71
	1913	.80		1913	.53
	1914	.83		1914	.80
	1915	.80		1915	1.05
June	1911	.82	December	1911	1.08
	1912	.82		1912	.72
	1913	.69		1913	.64
	1914	1.00		1914	1.02
	1915	.85		1915	1.10

Average price of lettuce during five years, 1911-1915 inclusive, compiled from table I.

TABLE II

Month	Av. price per crate	Month	Av. price per crate
January	\$1.01	July	.82
February	1.03	* August	.84
March	1.11	September	.91
April	.96	October	.96
May	.99	November	.97
June	.84	December	1.03

It will be noted that the highest prices are received from November to March, inclusive, and especially from December to March. The demand for California lettuce is heaviest during these months for long-distance shipments to the colder sections of the United States. During the summer months the eastern demand for California lettuce is comparatively small, due to the large amount of local lettuce in those markets.

Estimating the crop to be 2000 dozen heads and the price at 12½ cents per dozen, the grower would receive a gross income of \$250 per acre, and a net income of \$176.80. Considering that the land is in use only three to four months this would appear to be one of

the most satisfactory vegetables for the commercial and home garden. It will be understood that such returns are obtained only under favorable conditions by experienced growers.

#### CULTURAL REQUIREMENTS

*Soil*.—Lettuce is very exacting as to soil requirements and is best suited to a rich light loam. It should never be planted on soils of poor quality, for, although the plants will grow, the texture of the leaves will be tough and the heads small, both of which are very undesirable qualities.

*Moisture*.—Lettuce requires considerable soil moisture throughout its entire growing period, making irrigation necessary except during the rainy season. It is, however, easily ruined by an excess of water which makes possible a stem rot on the plants.

*Climate*.—Lettuce is a hardy vegetable and will stand, without injury, a low degree of temperature. Under this condition, however, the growth of the plant stops and a moderate temperature is desirable while the plants are growing. This crop will stand cold much better than heat, making it impossible to produce lettuce of good quality during the summer in many of the interior valleys of the state. When the weather is too hot and dry the plants will produce seed instead of heads.

#### PREPARATION OF THE SOIL

At the time of planting the soil should be in the finest possible condition and free from all weed growth. Many growers apply from fifteen to twenty-five tons of manure per acre. This should be applied long enough in advance of planting so that it may be plowed under and completely rotted by the time the field is ready for use. In the fall before the rains have commenced, the field should be heavily irrigated before plowing, but in the winter and spring months there is generally a sufficient amount of moisture without irrigation. After the soil has been worked into good condition, raised beds or ridges should be made either by the use of a hand hoe, or a special cultivator attachment. The latter implement is generally used where a large area is planted and the former where a small amount is grown. The beds should be from twelve to eighteen inches wide, four to six inches high, and the spaces between them ten to fifteen inches. After the beds have been prepared the field should be irrigated a few days before planting in order that the soil may settle.



Fig. 1.—Constructing raised beds.



Fig. 2.—After the raised beds have been roughly constructed, they may be smoothed over with a garden rake and irrigated.

#### PLANTING AND CARE OF THE SEED BEDS

The time of planting is governed entirely by the climate, and it is very important that the grower be acquainted with his local climatic conditions before growing this crop. For the interior valleys of the state the planting season generally starts during the last of August and continues until the first of March. Many growers make a first planting of the seed from the middle to the last of August, a second in October, and a third during January or February. Along the coast, where the climate is more moderate, it is possible to grow lettuce successfully during any month of the year.



Fig. 3.—Sunken seed beds.

There are two methods for growing lettuce, both of which are used extensively in California. The first is by planting the seed directly in the field, sowing it in drills on the borders of the raised beds; the second is to sow in seed beds and transplant the young plants into the field when they have attained the desired size.

There are several forms of seed beds in use, the most common being the sunken beds, which vary from three to six feet in width and eight to fifteen feet in length. The earth taken from these beds is hoed up to form a levee around each in order to aid in irrigating. Before planting, a heavy coating of well-rotted manure should be spaded under and the soil should be heavily irrigated just previous to seeding. The seed may either be broadcast or sown in drills, and

immediately covered with one-half inch of earth. If the soil is of a heavy nature so that it is liable to run together and bake when irrigated, a thin coating of well-rotted, screened stable manure should be applied on the surface before seeding. It will aid the seed in germinating if strips of burlap be placed on the soil and allowed to remain until the young plants are appearing at the surface. In removing this covering the young plants should not be exposed too suddenly to the light. During the warm months it is often necessary to irrigate several times before the young plants appear. The water may be applied either through a sprinkler or by flooding, using only a small stream so that the tender seedlings may not be injured. The amount of irrigation which the beds will need depends largely upon the character of the soil and the season of the year. During the early fall the beds are often irrigated three or four times a week, while later in the season one or two irrigations will prove sufficient. When the plants are one and a half to two inches tall the beds may be weeded and the plants thinned, leaving the distance between every two not less than one inch.

Under ordinary conditions the plants should remain in the seed beds six weeks, although the time required will vary from one to two months with the season of the year and care of the plants. When planting directly in the field three to four pounds of seed will be sufficient for one acre; at the University Farm Garden, 2600 square feet of seed beds raised a sufficient number of plants for one acre in the field.

When quick-growing plants are desired the seed should be sown in hotbeds in preference to the open beds. This form of bed is occasionally used during the winter and early spring.

*Removing the Plants.*—Plants may be transplanted when they are from two to four inches tall, the larger size being preferable during the warm weather. Before removing, the plants should be hardened by stopping the irrigation a few days in advance so that their growth may be checked. A few hours before the plants are to be removed they should be thoroughly irrigated in order that as much soil and as many fibrous roots as possible may be taken up with the seedlings. There are two methods for removing the plants. Those who have had considerable experience may pull them by hand. Those with limited experience, and especially if the soil is of a heavy nature, should dig them with the aid of a trowel or shovel. The plants should be constantly covered, after being removed, until they are planted in the field, for if exposed to the sun many of the small roots will be killed. If the seedlings are too large the leaves and roots should be

cut back. The best size of plant for transplanting is one having a top three inches tall and roots two inches long.

#### FIELD CULTIVATION

*Planting.*—The distance between the plants in the field varies from eight to fifteen inches. Where a variety producing large heads is grown, such as the Los Angeles, the plants should not be less than twelve inches apart in rows twelve inches apart, but if a smaller variety is used the spaces between the plants may be slightly reduced. If the seed has been sown directly in the field the plants should be



Fig. 4.—Setting lettuce plants in the field.

thinned when they are from two to four inches tall, and the vacant spaces filled with those which have been removed while thinning.

*Irrigation.*—A few days before planting, the field should be irrigated in order to settle the earth in the raised beds, and to show how far up on them the water will come. If this is not known many of the plants will be so high on the beds that they will not receive sufficient water, while others will be so low that they will be injured from an over-supply. As soon as the plants have been transplanted the field should be thoroughly irrigated, and it is especially important while they are young that frequent irrigations be given. In applying the

water care should be taken that it is not allowed to flow over the tops of the beds, and it will be found much more satisfactory to use a small stream, allowing it to run between the beds slowly, and thoroughly soaking into them, than a larger stream flowing more rapidly.

The number of irrigations which the field will require can only be determined by the condition of the plants. It is sometimes desirable to irrigate every week throughout the season, while under other conditions one or two irrigations will be sufficient. There should always be an adequate amount of moisture in the soil from the time the plants have commenced to head until they have matured, because the



Fig. 5.—“Scandigie” used for transplanting.

character and size of the heads is influenced to a great extent by the quantity of soil moisture present.

During the late spring if it is desirable to hold the crop in the field for a short time after it has matured, no more water should be applied, as it will increase the liability of the plants going to seed.

*Cultivation.*—When raised beds are used all of the cultivation will have to be done by hand, and the number of times which the field should be hoed will vary from one to five during the season. This will depend upon the character of the soil, the weed growth, and the thoroughness with which the beds have been made and irrigated. The soil need not be hoed between the beds unless there is a heavy growth of weeds. Occasionally water will flow over the tops of the beds and



Fig. 6.—Lettuce plants should be set at the edge of the moist earth.



Fig. 7.—When irrigating lettuce water should never be allowed to cover the plants.

these low places should be hoed after each irrigation if the soil has a tendency to run together, for the growth of the plants will be retarded if the earth close to them is allowed to harden.

#### HARVESTING<sup>3</sup>

The time required to mature a crop of lettuce varies with the season, the character of the soil, and the care. Plants set in the field during September should mature during November and December. Plants set in the field during November will mature from February to April, inclusive, and those transplanted during February and March will mature from April to June.



Fig. 8.—Lettuce should remain in the field until the heads have fully matured.

The period of growth at which the crop should be harvested depends largely upon the season, market requirements and prices. The California market demands a large solid head and the crop should remain in the field until it has reached this condition.

In harvesting it will be found most efficient to employ three men; one man cutting and two placing the heads in piles. During the spring when the weather is warm it is best to cut the lettuce early in the morning while it is cool and place it in the shade during the heat of the day, unless it is possible to ship immediately. The crop should never be cut when the heads are wet, as they will heat and quickly rot

<sup>3</sup> The following calendar is applicable to the interior valleys of the state, and especially to central California.

when packed in that condition. The field is generally gone over from three to five times during the cutting season, and the heads should be cut at the base, using a knife having a blade ten to twelve inches in length. After the crop has been harvested it should be handled very carefully and sold as soon as possible.

#### PACKING FOR SHIPMENT

Lettuce should always be packed for shipment in crates, especially when disposal is to be made at a considerable distance from the



Fig. 9.—Lettuce packed in the field for local market or packing house.

garden. There are three sizes of crates commonly used: the Los Angeles crate, which holds from three to five dozen and is twenty-four inches in length, eighteen inches in width and thirteen inches in height; the pony crate, which holds two dozen heads of ordinary size lettuce and is about one-half as large as the Los Angeles crate; and the field crate, which is about twice as large as the Los Angeles and holds about eight dozen heads of ordinary size lettuce. The Los Angeles and pony crates are most commonly used for long-distance shipments.

After the lettuce is cut it is hauled directly to the packing house where it is sorted, trimmed and repacked. That which is to be shipped a considerable distance, and especially during warm weather, should

always be protected from the heat; a layer of chopped ice should be placed between the bottom and the second layer of lettuce, and one on the top layer. If the pony crate is used the ice is put on the top layer only. The inside of the crates should be lined with heavy paper, which prevents the contents from drying and aids in keeping it cool. Lettuce is shipped in iced or refrigerator cars, the temperature of which should be kept as even as possible.

In filling the crates, the bottom layer should be packed with the stem ends down and the others reversed, thus protecting the heads from injury in transit. After the crates are packed they are placed immediately on cars and rushed to their destination. An ordinary sized car holds from 300 to 310 crates.

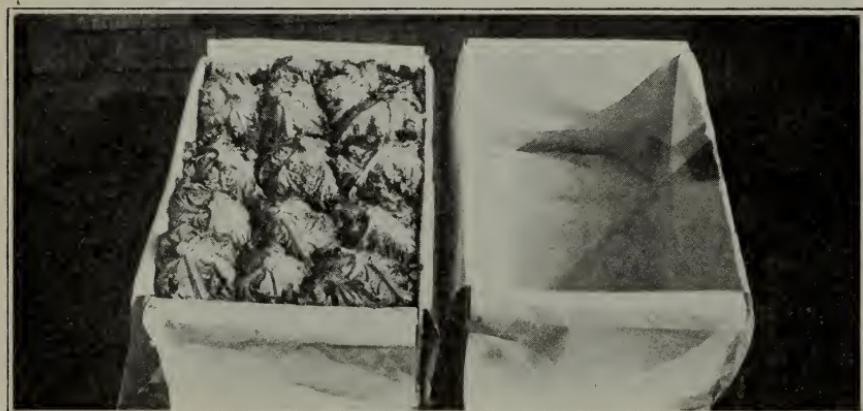


Fig. 10.—Lettuce re-packed for long distance shipment and empty crate lined with paper preparatory to packing.

#### VARIETIES

There are a large number of varieties of lettuce under cultivation. Robinson in his book, "The Vegetable Garden," names over one hundred and twenty-five.<sup>4</sup> At the University Farm Vegetable Garden during the past season, eighty different varieties were grown, most of which did well under our conditions. Of this large number, however, there are a comparatively few which meet the demand of the California buyers. The four leading varieties which are now being produced in this state are the Los Angeles or New York Market, the Iceberg, the California Cream Butter, and the Hansen.

*Los Angeles*.—This variety is by far the most popular and is especially adapted for long-distance shipments. The head is large, solid, tender, an excellent shipper, and matures quickly. The outer leaves are dark green in color,

<sup>4</sup> W. W. Robinson, "The Vegetable Garden," pp. 362-399.

but the head is well bleached and excellent in flavor. This variety will withstand cold without injury but is not adapted to maturing during hot weather as it quickly goes to seed.

*Iceberg*.—This variety is grown extensively and is especially adapted to maturing during the hot weather. In size and general appearance, it is quite similar to the Los Angeles variety, the main difference being a reddish tinge on the edges of the leaves. This is a good shipping variety.

*California Cream Butter*.—This variety is commonly grown and is similar to the Big Boston. It has a rich creamy taste from which, presumably, it derived its name. The head is light green and tinged with brown. The outer leaves are slightly spotted with inconspicuous brown spots.

*Hansen*.—This is a desirable variety for local market. The leaves are a lighter green than those of the Los Angeles. The heads are solid and have a good flavor.



Fig. 11.—Los Angeles.

#### CROP TROUBLES

*Securing a Stand of Plants*.—It is often difficult, especially during hot weather, to secure a satisfactory stand, either when planting directly in the field or when sowing in seed beds. Aside from the climatic influence, the germinating power of the seed, over-irrigation, or applying insufficient quantities of water are often responsible for this condition. In controlling this trouble the grower should determine which of the foregoing causes is responsible and remedy it if possible. (For detailed directions for the construction and care of the seed bed, see page 7.)

*Stem Rot*.—This disease is present in the fields during winter and early spring; it is most prevalent on heavy soils, and especially severe

where drainage is poor. Soon after it appears, the plants will become a sickly yellow color and the stems will rot at the surface of the ground. These diseased plants may appear promiscuously throughout the field, or may be in certain well-defined areas. This is a fungus disease which thrives best under excessive moisture conditions. For control the grower should improve the drainage so that no water will be allowed to stand on the field, and the beds should be made high enough so that the water will not stand directly around the plants.

*Sunburn*.—This trouble is characterized by a blackening of the edges of the leaves inside the heads. It is often impossible to know that this condition exists without cutting into the head. Severe losses are sometimes occasioned, especially in the crop maturing during the late spring. Occasionally these affected plants will rot during shipment. The cause is a period of excessive hot weather from the time the plants are half-grown until they have commenced to head. Planting in the fall or early spring will largely control this disease; if the weather is very hot and dry during the spring the plants should be irrigated frequently.

*Failure to Produce Solid Heads*.—This condition is caused either by a poor quality of seed, an insufficient supply of moisture, or unfavorable climatic conditions, such as excessive hot weather while the plants are maturing. This may be largely overcome by using only well-selected seed and applying sufficient moisture at the time the heads are maturing. During the late spring when the weather is hot the crop should be harvested immediately after the heads have matured.